HURON MOUNTAIN WILDLIFE
FOUNDATION

Summer 2022
Newsletter

Rich Flora On Tall Rocks

By Jill Riddell

Three Huron Mountain Wildlife Foundation researchers have been collaborating since 2012 on a long-term project that compares the communities of plants that grow on boulders with those that grow on the forest floor. The research tests the degree to which increases in deer population have changed the understory of the Huron Mountains forests.

Over the past eighty years, browsing by overabundant white-tailed deer has profoundly changed the landscape hikers and hunters encounter in the Hurons. Dr. Walter Carson, an associate professor of ecology at the University of Pittsburgh, Rose-Marie Muzika, the director of research and collections at the Carnegie Museum of Natural History, also in Pittsburgh; and Dr. Thomas Diggins, a professor of biology at Youngstown State University in Ohio have confirmed that deer-induced effects have reduced plant diversity, have shifted around which types of plants can survive, have caused the loss of some plant species, and have stripped away the natural vegetation structure, transforming the woods into something less complex.

That Was Then, This is Now

To understand why researchers want to study the tops of boulders, first it helps to understand how different the forests in the Huron Mountains have become in the past century. Today, a hiker can peer ahead on the trail and see everything for a long way off, but in in the late 1800s and early 1900s, views would likely have been obscured by thick clumps of Canada yew and other plant species growing in the understory of the forests. The hiker of a century ago would also have observed many more species of flowering plants than today's hiker.

Time-travelers from that period arriving in ours would be shocked because today, the current forest floor has zero stems of dense, bristly Canada yew. There's hardly anything at all surviving in the mid-level range of vegetation (four-to-six feet tall.) White-tailed deer have eaten everything that their height allows, and therefore, most human residents have never seen a healthy forest understory anywhere in the Upper Peninsula.

This is because Europeans who began settling in North America in the 1600s started altering landscapes in ways that didn't benefit deer, plus they overhunted the animals. Around the time when the Huron Mountain Club first formed and the first homes at Conway Bay were being built, there were periods when white-

Once common, populations of Canada yew have greatly declined. "At the Club, hundreds of boulders exist of the type we study, and we have surveyed somewhere around 65 of them so far," says lead researcher, Dr. Walter Carson. "Only three have Canada yew." ***Illustration by Lynda Wallis***
"If you climb up to examine the top of a boulder, you'll see a heavy moss cover on it, which is what keeps keeping the soil in place. Some boulders are remarkably well-covered with vegetation. It's impressive to see trees and high shrubs growing head-high on top a rock with only inch of soil," says Dr. Thomas Diggins, professor at Youngstown. ***Photo by Thomas Diggins***

Mountain maple is one of the species whose numbers have been radically reduced by deer browse. (For a list of species numbers are up and down due to deer, see sidebar.) *Photo by Thomas Diggins*

tailed deer populations were so low that deer were in danger of regional extinction. But after regulations on hunting were put in place in 1921, deer populations surged. Forests that had been logged provided better habitat for deer than old-growth did, which helped deer populations expand, and because natural predators of deer–wolves, bears, mountain lions–had also been overhunted, little stood in the way of a triumphant return for white-tailed deer.

Surveying Refuges in the Huron Mountains–Why Boulders?

It makes intuitive sense to assume that nothing can grow on solid rock, but that's not the case. Over thousands of years, thin layers of soil manage to form. Pine needles, bird droppings, seeds, spores and other organic matter land by chance; mosses spring up, and these and other pioneer plant species enrich and moisten the soil for successive waves of other plants. If a boulder is sufficiently rained upon and if it experiences occasional beams of sunlight, eventually its top comes to support a community of vascular plants, fungi, insects, lichens, and microorganisms.

"You can imagine that the plants don't love rock, right?" says Dr. Carson. "The depth of the soil on top of boulders is less than three centimeters–it's just dying organic matter, really. But the plants don't really care. They still grow better on top of a rock with shallow soil than they do on a forest floor where they get browsed by deer."

Tall boulders are characterized by a diverse mix of forbs, shrubs, and understory trees that contrast sharply with the sparse understory of the forest floor, which is dominated by sugar maple seedlings and saplings. The now-rare favorite foods of deer like Canada yew, mountain maple, mountain ash, and native honeysuckle can be found almost exclusively on boulders and only rarely on the ground.

"At the Club, hundreds of boulders exist of the type we study, and we have surveyed somewhere around 65 of them so far," says lead researcher, Dr. Carson. "Only three have Canada yew."

To further understand this, the researchers evaluated boulders of varying heights, and compared the quantity and type of vegetation on the boulders with the vegetation on the forest floor. Total vegetation cover was three times higher on tall boulders and diversity was 39% to 58% higher on tall boulders than it was either on low boulders that deer could easily reach or than it was upon the ground. More than three-quarters of the comparison plots on the forest floor were completely bare. Forbs were four times more abundant on tall boulders, and both subcanopy trees and shrubs were about 10 times more abundant on the refuges offered by tall boulders than they were on the ground. Of the most common species, only sugar maple was more abundant in ground plots than it was on boulders.

"We want to know what plants are present up on the rocks, and we also want to evaluate the viability of that plant community," says Dr. Muzika. "We look at reproduction: is a species persisting? Does it produce flowers and seeds? We want to establish whether what grows on top of the boulder in the absence of deer is in a different condition from what it would be if it were growing on the forest floor. It may look intact, but does it really function?"

Size of Boulders, and Why Deer Don't Disturb Them

Deer are nimble animals, so it may seem puzzling that they don't scramble up the sides of boulders to eat their preferred plants. Why are boulders successful as a refuge?

"Most boulders in our study are over a meter and a half tall. It's true, a deer can jump over a high fence, we've all seen them do it but that doesn't mean the deer wants to. Typically you'll see a deer run or walk long distances along a fence line to avoid having to jump. If they can push under a fence, they're just as likely to do that as they are to leap it," says Dr. Carson. "Also, deer aren't great climbers–they're not like goats. The boulders we study don't have to be perfect–it's not like we've never seen evidence of deer having been up on some of them. They just have to be tall enough to give the plants a break from continuous browsing."

The boulder research team enclosed and monitored a small area of vegetation on the ground near a study boulder to exclude deer, and to compare flora growing on the forest floor with that of the rock. *Photo by Thomas Diggins.* From left: Rose-Marie Muzika, Tom Diggins, Walter Carson

Dr. Muzika says, "When you see photos in National Geographic or nature specials on TV where they show areas with high plant diversity or unique plant communities, often you might notice people looking over the edge of cliffs to see plants that grow nowhere else. Areas rich in diversity tend to be somewhat inaccessible."

Historical Research, Future Projections

"One reason we can be so confident about saying certain plants that now are rare once occurred widely is because there was a very early inventory of plants at the Huron Mountain Club conducted by Charles K. Dodge in 1918. We can compare that study with what we see now," says Dr. Muzika. "Species of plants that once were common but that deer love to eat are really quite rare now."

In the report for the Huron Mountain Club that Aldo Leopold completed in 1938, Leopold expressed concern even then about the growing size of the deer herd, noting signs of heavy browsing pressure on preferred browse species.

Deer have already reduced understory cover by nearly 70%, and replaced a diverse mix of forbs, shrubs, and subcanopy trees with a nearly barren understory dominated by sugar maple. Without the reference point provided by boulder refugia communities, the status of this forest relative to historic conditions would have remained largely unknown.

"All systems are changing in unpredictable ways – forests included. and while there may be depauperate regeneration in the Huron Mountain ecosystem, owing to deer, or human intervention, or climate changes, there remain so many unpredictable factors, many of these also human-caused. When we consider the loss of majestic hemlocks due to the presence of deer (or more accurately, from the loss of major natural predators that would otherwise be keeping the deer in check) we also have to remember that there are invasive insects, species that are causing the demise of hemlocks through the range of this tree species, from New England to the Carolinas. I believe that the UP has yet to see this insect invade, but it is likely inevitable," says Dr. Muzika. "A vast accumulation of causes creates the changing character of the forest."

Notes from Kerry Woods: The insect referred to is the hemlock wooly adelgid. It's not yet shown itself in northern Michigan but there is an infestation in the Lower Peninsula. Also, another long-term study of deer effects in the Hurons conducted by Don Waller was featured in the Summer 2013 newsletter. The two studies are nicely complementary.

PLANTS THAT INCREASE & THOSE DECREASE

Deer, on average, consume 4 to 8 pounds of browse per day for seven months of the year. Like humans, deer have foods they favor and ones they don't. By selectively browsing preferred species, deer have changed the composition of species found in the Huron Mountains.

Plants that thrive because deer don't favor them include:
Ferns
Striped maple
Blueberries

Plants that have been reduced, eliminated, or that aren't able to regenerate because of deer browsing include:
Eastern hemlock
Northern white cedar
Mountain maple
Mountain ash
Canada yew

Hemlock seeding that's been stunted by the browsing of one or more deer. *Photo by Thomas Diggins*

Environmental Change, Slow Systems, and the Invisible Present: Review of 2022 Projects

By Kerry Woods

In 1990, Dr. John Magnuson of the University of Wisconsin published a provocatively titled paper, "Long-term Ecological Research and the Invisible Present." Magnuson argued that our understanding of the nature of ecosystems – the "present" – was fundamentally undermined by our short-term perspective and mindset.

Ecosystems exhibit dynamics that manifest over the scale of decades and centuries – they are "slow systems." Clear understanding of how environment shapes ecosystems and of the effects of environmental change require long-term perspectives and data-sets maintained for decades. Yet most ecological studies persist at most for three to five years—and many last only a single season.

Even as the urgency of understanding the effects of environmental change increases, Magnuson's challenge remains. Within the biological sciences, the practical difficulties of undertaking long-term research projects are huge. Because analysts trying to understand big questions seldom have solid long-term data-sets they can rely upon, ideas about ecosystem dynamics and the effects of environmental change, even in scholarly texts, involve poorly-tested assumptions.

The pressing need to address this problem informs the work of the Huron Mt. Wildlife Foundation. The Huron Mountains offer a uniquely powerful vehicle for addressing the "invisible present" dilemma. As one of the largest areas in the Great Lakes region that has not been subject to intensive human management, the Huron Mountains serve as a "reference" ecosystem where ecological dynamics are less affected by human land-use. The rigorous protection of this landscape coupled with the Foundation's consistent support for long-term studies make it possible to surmount the logistical challenges inherent in decade-scale research. HMWF's research program supports many projects emphasizing these values.

Looking into the past

A long temporal view of environmental and ecological dynamics can be achieved by research that "looks backward" in time. In the recent past, HMWF has supported studies using plant and animal remains preserved in lake and bog sediments to understand historical ecological conditions. Currently, two projects are using powerful "dendrochronological" approaches – tree-ring studies. Growth rings of trees support models of past environments through correlations between seasonal growth rates and various aspects of climate.

Previous studies have used this approach by studying cores from selected living trees. Cores from living trees can stretch our knowledge back a maximum of about 400 years, to the 17th century. Current studies will extend tree-ring records even further back in time by taking cores from logs that have been long submerged in lakes. Cold water temperatures and low oxygen levels in northern lakes preserve ancient logs, making it conceivable that researchers will be able to extend Huron Mountains' tree ring records from 400 years ago to 1,000 years ago. **Steve Voelker (Michigan Technological Univ.)** is completing a three-year study sampling submerged logs in several lakes. A multi-institution team – **Evan Larson (Univ. Wisconsin-Platteville), Daniel Cziczo (Purdue University),** and **Rose-Marie Muzika (Carnegie Institution)** – also in the third year of a broader study, will focus efforts this year on Canyon Lake, where steep cliffs host slow-growing conifers and are likely to feed many logs into the lake.

Betsy Swanner (Iowa State Univ.) and **Chad Wittkop (Minnesota State-Mankato)** are in the ninth year of their geochemical studies of Canyon Lake. While not specifically focused on reconstructing environmental history, the researchers are particularly motivated by the unusual properties of Canyon Lake's never-mixing deep waters, which may provide a valuable analogue for Earth's early oceans.

Long-term experiments and monitoring

Direct, "longitudinal" monitoring of populations and ecosystems over many years is critical for testing hypotheses about ecological-environmental interactions in real systems. HMWF welcomes researchers addressing the daunting challenge of long-term studies, and this year's program includes several examples:

Deserving of their own paragraph, **Ken Hinkel** and **Fritz Nelson** have maintained monitoring and analysis of microclimatic patterns across the Hurons for over 20 years. Currently, they're expanding the primary study based on a network of climate monitoring stations to include surveys of snow-pack dynamics. Important in its own right, this study also will provide baseline information useful for a number of other researchers.

Two studies focus on the effects of elevated deer populations on forest dynamics. **Don Waller (Univ. of Wisconsin-Madison)** and collaborators are in the twelfth year of studying a large "deer exclosure" in the Fisher Creek area – one of a network of such experiments across the upper Midwest – and will be conducting intensive, ten-year remeasurement of the protected forest. **Walter Carson (Pittsburgh Univ.)** and **Rose-Marie Muzika (Carnegie Institution)** are well into long-term studies of natural "refuges" for deer-sensitive plant species on inaccessible large boulders and ledges, with a particular interest in whether these small habitats can serve as sources for recolonization of the forest floor generally if deer herbivory pressures are relaxed. [See cover story for more on this one.]

Focusing on long-term dynamics of particular populations, **Jalene LaMontagne (DePaul Univ.)** is in the 11th year of monitoring patterns of cone and seed production and associated environmental and growth variables in white spruce. This year, she will expand the study to include other conifers. **Dennis Riege (Univ. of Maryland, emeritus)** has used monitoring of several large, long-term study plots over more than 15 years to gain insight into the ecology of the iconic white pine.

Several studies contribute to a deepening archive of long-term studies in aquatic systems. **Casey Huckins (Michigan Technological Univ.)** continues multi-decade monitoring of the ecosystems and fish communities of the Salmon Trout River, with special focus on the unique and endangered coaster brook trout population. **Karen Murchie (Shedd Aquarium)** includes two Huron Mountain streams in her regional study network focused on understanding what regulates the annual spawning migrations of suckers; now in its sixth year, this project will continue for at least a decade. **David Costello (Kent State Univ.)** is continuing studies of how rare elements (mainly metallic micronutrients) can affect productivity of critical microbial communities in streams. (As in several other cases, Costello's study is following up on earlier work to convert an initial short-term project into a long-term study.) In its 15th year, **Donna Kashian's (Wayne State Univ.)** ongoing study monitors steam invertebrate communities in a number of regional streams. It uses Huron Mountain streams as reference ecosystems for assessing the effects of human activities in watersheds. This year's work will add mussel communities to the long-term data-set.

Collaborations building on past and ongoing studies

One of the most potent approaches for gaining long-term perspectives is through generational collaborations, with new researchers building upon past studies and data-sets. One of HMWF's most valuable roles is facilitating such connections. We have seen many examples, and several current projects fall in this category.

In 1962, Eric Bourdo of Michigan Tech established forest study-plots at several locations in the Hurons. While Bourdo monitored these plots for only five years, I was able to relocate them (along with some plots that I established during my dissertation work) in 1989 and have been monitoring them on a five-year cycle ever since. This data-set, now one of the longest-term demographic records for old-growth forest communities, has supported several other studies. A new study, led by **Julia Burton (Michigan Tecnological Univ.)** is designed to tease out relationships between physiological and anatomical traits of canopy trees and their growth rates and response to environmental variation, with the goal of better understanding what regulates carbon sequestration rates in old-growth forest. By placing this project in the context of the Bourdo plots, Burton will be able to build on decades of measured growth rates for the same trees she studies.

Two studies address the effects of invasive earthworms (all common

page 5

Photo by Tim Brown

ALL ARE WELCOME

Annual Meeting
Tuesday, August 2
4:00 p.m.
The Playhouse

Keynote Speaker: Dr. Jalene LaMontagne
"The Highs and Lows of Cone Production"

Dr. LaMontagne is an Associate Professor of Biological Sciences at DePaul University, and is an Adjunct Scientist with the Urban Wildlife Institute at the Lincoln Park Zoo. She's also a former Manierre Award winner. Her research concentrates on how patterns in plant and animal populations change across landscapes and how they're impacted by their environments. Dr. LaMontagne alternates between work on white spruce trees in remote, northern regions (including the Huron Mountains) and urban work in Chicago, where she researches wildlife species found in the city.

Field trips with scientists -TBA

Kerry Woods and other scientists may be conducting field trips around the time of the annual meeting. Look for posted signs.

page 4

earthworms in the northeastern U.S. are non-native and invasive), and both are linked to past work, taking advantage of research mapping earthworm invasion fronts 15 years ago. **Xiaoyong Chen** and **Mary Carrington (Governor's State Univ.)** address the effects of earthworm presence on soil structure and function; this study is also linked to the long-term studies on the Bourdo plots mentioned above. **Tara Bal (Michigan Technological Univ.)** is evaluating the effects of earthworm presence on sugar maple health, especially the sugar content of sap. While this study targets application in the maple sugar industry, it benefits from the reference ecosystem properties at the Hurons, where the effects of earthworms can be separated from the effects of past forest management.

Documenting Biodiversity

The Huron Mountain area is already well-established as a biodiversity "hot spot." The next update to the All-Taxon Biodiversity Inventory (http://www.hmwf.org/atbi/) will bring the total number of documented species for Huron Mt. Club lands to around 5,500, but this is certainly very incomplete; the true species diversity of the area is certainly much higher. Biodiversity studies are also critical for understanding long-term ecological responses to environmental change; careful documentation of existing biodiversity is essential for recognizing additions and losses to the biota. Several projects continue this effort.

Jim Bess (Northland Environmental Services), Thomas Werner (Michigan Technological Univ.), David Houghton (Hillsdale College), and **Patrick Gorring (Michigan State Univ.)** are all continuing multi-year studies of a range of insect groups. Over the last few years, Werner and Bess have added over 400 species of moths and butterflies to the known fauna. Werner has also documented a number of new species of fruit-flies, while Bess's work has also focused on leafhoppers and their kin, and, this year, will extend to bees and wasps. Houghton's studies of aquatic insects have, so far, added over 100 species of caddisflies to regional diversity of the group. Gorring's work has added new species to an already-long lists of beetles in the Huron Mountains. These studies have documented many new state records, major range extensions, and potential new-to-science species.

Jason Karakehian (Illinois Natural History Survey) in an initial survey in 2021, found unsuspected diversity and biogeographical novelty in little-known groups of dry-wood-inhabiting fungi. With a team of colleagues, he's expanding on this work this summer. **Anne Pringle (Univ. of Wisconsin-Madison)** plans to use modern and traditional tools to better map suspected but undescribed diversity within the "destroying angels" mushrooms *(Amanita virens),* a group previously "lumped" across northern Europe and North America as a single species, but possibly containing a number of distinct genetic entities.

While the vascular plant diversity of the Hurons is very well documented – only a handful of new, mostly non-indigenous, species have been added in recent years – better understanding of genetic diversity within known taxa (species and hybrids) remains important. **Susan Fawcett (Univ. of California – Berkeley)** is initiating studies of genetic relationships in the complex fern genus, *Dryopteris* (the wood ferns), following up on several existing studies of Huron Mt. ferns. Aquatic habitats are probably less well documented, botanically, and may be particularly vulnerable to invasion. **Susan Knight (Univ. of Wisconsin, Center for Limnology)** is in the third year of a systematic survey of aquatic plant communities in several HMC lakes.

Sarah Shainker Connelly (Univ. of Alabama at Birmingham) is using analysis of samples of environmental DNA (eDNA) – DNA extracted from material scraped from rocks in streams – to better document the diversity of red algae. Red algae are important in marine systems, but also present in fresh water in difficult-to-document life-forms. eDNA approaches are likely to become a powerful tool for better documentation of difficult to observe taxa.

Important elements of biodiversity can exist in genetic variability within species or in genetic relationships between species. **Cody Thompson (Univ. of Michigan, Museum of Zoology)** is in the seventh year of a study examining potential hybridization between expanding populations of southern flying squirrel and the increasingly rare northern flying squirrel in northern Michigan.

Reference ecosystems

Two new studies, while not explicitly "long-term" (yet), are good examples of the scientific value of the reference ecosystem qualities of the Huron Mountains. **Heather Dawson (Univ. of Michigan-Flint)** is using concentrations of environmental pollutants in tissues of fish from the relatively pristine streams of the Huron Mountains as a comparative baseline for assessing effects of higher pollution levels in streams of southern Michigan. The project also seeks to discover whether differences in environmental toxins are associated with differences in gene expression and physiological function.

Ryne Rutherford and **David Flaspohler (Michigan Technological Univ.)** are documenting the biogeographically distinctive biota of the "granite bedrock glades" of the region, with particular interest in understanding how human usage affects these fragile communities. The Huron Mountains, again, offer an important baseline in this assessment.

Upcoming New Initiatives

I have focused here on the list of current research projects, but also want to mention two other initiatives. After a pandemic-caused hiatus, we have revived the "artist-in-residence" program, initiated in 2019. Many field-stations and natural areas offer such residencies, finding that the interactions between scientists and artists in the field can be powerfully generative for both, and that the products of these residencies can be valuable in communicating and promoting the core scientific work. We have two new residencies this summer. I am excited about the possibilities, and look forward to showing the resulting work.

Finally, returning to our primary agenda of promoting field research in the Huron Mountains landscape, and the theme of building collaborative research programs, we have begun working with HMWF-sponsored researchers to make sure that data-sets resulting from their work are appropriately documented and deposited in permanent, accessible data-archives. We are pushing researchers towards depositing all data from HMWF-sponsored projects in one of several internet-based repositories. The uniqueness of the Huron Mountains ecosystem makes such permanent archiving particularly important. The data-sets we collect now for this reference ecosystem will have critical value for researchers indefinitely into the future.

Once again, I thank all of the Foundation's supporters for making all of this possible. I hope it is gratifying for all, as it is for me, to see this support translated into a body of research, both archival and continuing, with ever-increasing power and impact.

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The Huron Mountain Wildlife Foundation wishes to thank the following donors for making the original research in a wide variety of fields possible. We work hard to capture all donor information accurately, so if you see any omissions or oversights, please let us know.

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Since 1955, the Huron Mountain Wildlife Foundation has supported original research in a wide variety of scientific fields. The research takes place in the Upper Peninsula of Michigan. More information on the Foundation can be found at: **www.hmwf.org**

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